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ABSTRACT

Purpose: Adhesive capsulitis is a condition in which the tissues of the shoulder joint become tight and impede movement. It is characterized by gradual loss of both active and passive glenohumeral joint motion, resulting in fibrosis, scarring and contractures of the joint capsule. Patient with adhesive capsulitis usually have difficulty in performing overhead activities, as well as routine duties such as combing their hair, dressing themselves, and throwing a ball. The objective of this study was to determine the effectiveness of proprioceptive neuromuscular facilitation (PNF) stretch vs muscle energy technique (MET) on pain and disability in patients with adhesive capsulitis.

Methodology: Study Design: This research employed a rigorous single-blinded randomized controlled trial design to investigate the comparative effectiveness of two manual therapy techniques in the management of adhesive capsulitis. The study was conducted in accordance with established ethical guidelines and principles. Participant Selection: A total of 30 participants, aged between 30 and 60 years, were recruited for this study. The selection process adhered to specific inclusion and exclusion criteria to ensure the homogeneity of the participant group. Inclusion criteria encompassed individuals in the 2nd and 3rd stages of adhesive capsulitis, both males and females, those with comorbid conditions such as diabetes and hypertension, and individuals experiencing painful restrictions in active and passive glenohumeral or periscapular motion. It was essential that participants had the ability to understand Punjabi or Urdu and were willing to participate. Exclusion criteria included individuals with a history of post-traumatic immobilization, cognitive impairment, previous surgery or arthroscopy, cervical pathology, neoplasm/tumor, or reflex sympathetic dystrophy. Informed Consent: Before the commencement of the study, informed consent was obtained from all participants. The participants were fully informed of the study's objectives, procedures, and potential risks and benefits. The rights of voluntary participation and the option to withdraw from the study at any time were emphasized. Participant data were anonymized and kept confidential throughout the research process to safeguard privacy. Randomization: To minimize bias, participants were randomly assigned to two distinct treatment groups, Group A and Group B. The randomization process was conducted using a computer-generated method, ensuring that each participant had an equal chance of being assigned to either group. Interventions: The study employed two distinct manual therapy techniques for the treatment of adhesive capsulitis. Group A received proprioceptive neuromuscular facilitation (PNF) stretching, while Group B underwent the Spencer muscle energy technique (MET). Both

interventions were administered over a duration of one month. Baseline Treatment: In addition to the primary interventions, all participants received a hot pack as a baseline treatment. This standard treatment approach aimed to create a consistent baseline condition for all participants and to alleviate any discomfort. Data Collection: The collection of data was a crucial aspect of this study. Data were gathered through the utilization of structured data collection forms, designed to capture demographic information and adhere to the inclusion and exclusion criteria. Additionally, standardized assessment tools were used to quantify outcomes. The Shoulder Pain Assessment Disability Index (SPADI) was employed to evaluate both pain and functional disability, while the Numeric Rating Scale (NRS) was utilized to measure pain intensity.

Findings: Statistical analysis was done by using statistical package for the social sciences (SPSS) version 28. The collected data was analyzed and presented using appropriate statistical techniques. The data were initially checked for normality using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Non-parametric tests were employed due to the non-normal distribution of the data. Qualitative data were analyzed for frequency and percentage. Intra-group differences were examined using the Wilcoxon signed-rank t-test, while inter-group differences were assessed with the Mann Whitney U-test. Spencer mean Mets treatment group has lower mean ranks in total SPADI pain as compared to PNF study group.

Conclusion: the study concluded that Spencer Mets has been more effective in reducing the pain of the patients as compared to PNF treatment. Healthcare professionals involved in the treatment of patients with adhesive capsulitis should consider the incorporation of Spencer MET as a viable option for pain management. The superior pain reduction observed in this study suggests that this technique may yield favorable results in real-world clinical settings. While this study offers valuable insights, further research is warranted to explore the long-term effects and potential differences in functional outcomes between Spencer MET and PNF treatment. Comparative studies with larger sample sizes and extended follow-up periods can provide a more comprehensive understanding of the benefits of these techniques.

Keywords: Adhesive Capsulitis, Frozen Shoulder, Muscle Energy Technique, Proprioceptive Neuromuscular Facilitation, Manual Therapy Treatment

1.0 INTRODUCTION

Frozen shoulder, medically known as adhesive capsulitis, is a debilitating condition characterized by the thickening and contracting of the glenohumeral joint capsule over time. This leads to gradually worsening symptoms of pain and restricted shoulder mobility, ultimately affecting an individual's daily life. The condition typically follows an insidious onset, where symptoms develop slowly but can persist for months to years, often disrupting sleep and making simple tasks like dressing or combing hair challenging (1). Patients with frozen shoulder frequently describe an insidious beginning, with pain gradually increasing and active and passive range of motion gradually decreasing (2). Adhesive capsulitis is a severe illness in which the glenohumeral joint capsule thickens and contracts with time (3).

Patients with frozen shoulder experience an array of symptoms, with pain and the progressive loss of active and passive range of motion being the most prominent. The condition typically evolves through four stages: the painful phase, freezing stage, frozen stage, and thawing stage, each characterized by distinct clinical features and durations (4). Loss of external rotation (ER) in a dependent position with the arm down by the side is one of the most common symptoms. Grooming, above tasks, dressing, and especially securing objects behind the back are all common difficulties for patients. Frozen shoulder is thought to be a self-limiting condition, with reports of symptom relief ranging from 6 months to 11 years.

Unfortunately, many patients' symptoms may never completely go away (5). Adhesive capsulitis, unlike more serious causes of shoulder pain, does not exhibit red flag symptoms like fever, night sweats, or unexplained weight loss (6). Diagnosing frozen shoulder primarily relies on clinical examination. Physicians assess a patient's range of motion and the presence of associated discomfort during specific movements. Radiological imaging, such as X-rays or MRI, may be recommended to rule out other conditions if needed, although it's typically not required for diagnosis (7). Frozen shoulder shares symptoms with various other shoulder pathologies, including rotator cuff injuries, calcifying tendinitis, and cervical radiculopathy, making its accurate diagnosis crucial. Distinguishing between these conditions can be challenging, underscoring the importance of a thorough clinical evaluation (8). Certain factors predispose individuals to frozen shoulder, with diabetes, thyroid disorders, and prior shoulder injuries or surgeries being notable risk factors.

Frozen shoulder is more common in women and typically affects individuals aged 40 to 65, although it can occur in people of all genders and age groups. The prevalence in the general population ranges from 2% to 5%, but it can be as high as 10% to 20% in diabetic patients, making diabetes a significant risk factor (9). Managing frozen shoulder involves a multifaceted approach. Conservative treatments, including physical therapy, pain management, and home exercises, are often the first line of defense. These approaches aim to alleviate pain, improve mobility, and enhance overall function. In refractory cases, more invasive interventions such as corticosteroid injections or surgery may be considered (10). Two innovative techniques, the Spencer Muscle Energy Technique (MET) and Proprioceptive Neuromuscular Facilitation Stretch (PNF), have shown promise in managing frozen shoulder. The Spencer MET, developed in 1916, focuses on mobilizing the glenohumeral and scapulothoracic joints, aiding in the restoration of shoulder range of motion (11).

PNF stretching, developed in the 1940s, triggers reflexes to achieve deeper stretches, effectively improving flexibility and range of motion. (12). This technique involves various methods, including the "hold-relax" and "contract-relax" techniques, making it a versatile tool in the management of frozen shoulder. While the self-limiting nature of frozen shoulder offers some hope for symptom

relief, many patients continue to experience pain and functional limitations for extended periods. This prolonged suffering can adversely affect their overall well-being, daily activities, and overall quality of life. It is imperative to explore and evaluate treatment techniques that offer the potential for effective pain reduction and functional improvement in individuals with adhesive capsulitis. This study was guided by the theoretical framework that effective manual therapy techniques can significantly impact the management of frozen shoulder.

The use of two specific techniques, the Spencer Muscle Energy Technique (MET) and Proprioceptive Neuromuscular Facilitation Stretch (PNF), was grounded in the understanding that these methods could address the key elements of the condition—pain and limited range of motion. The Spencer MET, developed in 1916, is based on the principles of mobilizing the glenohumeral and scapulothoracic joints to restore and improve shoulder range of motion. This technique is rooted in the concept that targeted joint mobilization can facilitate improved function and alleviate pain. Similarly, the PNF stretching technique, which originated in the 1940s, capitalizes on the reflexes of the neuromuscular system to achieve deeper stretches and enhance flexibility and range of motion. The "hold-relax" and "contract-relax" techniques within PNF stretching offer versatility in addressing the functional limitations associated with frozen shoulder.

2.0 METHODOLOGY

the interventional study conducted at the outpatient department of District Head Quarter (DHQ) Hospital in Faisalabad, a prominent city known for its agro-based and industrial activities. The study design is described as a quasi-experimental study, utilizing simple random sampling to select a sample size of 40 participants over a duration of 3 months from the approval of the synopsis. Inclusion Criteria of the study was, Age: 30-60 years, both males and females, Patients in the 2nd and 3rd stages of Adhesive Capsulitis, those with diabetes and hypertension, Individuals experiencing painful restriction of active and passive glenohumeral or periscapular motion, Ability to understand Punjabi/Urdu, Willingness to participate.

Exclusion Criteria was Patients with post-traumatic immobilization, Cognitive impairment, Previous surgery/arthroscopy, Cervical pathology, Neoplasm/tumor, Reflex sympathetic dystrophy. The study employed various data collection tools, including: Data Collection Performa: This tool gathered demographics and selection criteria information. Follow-up Performa: Used to detect pre-session (before the 1st session) and post-session (after the 12th session) values. Questionnaire: Utilized the Numeric Rating Scale (NRS) for pain assessment and the Shoulder, Pain and Disability Index (SPADI) to evaluate both pain and functional disability. The collected data was interpreted using specific formulas:

Interpretation of SPADI scores, which includes total pain and disability scores. Interpretation of NPRS scores, ranging from 0 (No Pain) to 10 (Worst Possible Pain).

Ethical considerations were paramount throughout the study: Ethical clearance was obtained from the Hospital Ethical Committee. Informed consent was acquired from all participants, ensuring they fully understood the study's purpose and procedures. Participants were informed of their voluntary participation rights, with the freedom to opt in or out of the study. Anonymity and confidentiality of participant data were maintained to protect their privacy. Two treatment protocols were employed in the study: Proprioceptive Neuromuscular Facilitation (PNF) Stretch: Administered in a diagonal (D2) flexion and extension pattern for 5 repetitions per set, 2 sets per session, 1 session per day, 3 days per week for 1 month. Spencer Muscle Energy Techniques (METs): Administered in seven different movements of the shoulder pattern for 1 month at a rate of 5 repetitions per set, 2 sets per session, 1

session per day, and 3 days per week. Each repetition was maintained for 5–10 seconds, preceded by 10 minutes of hot pack treatment.

Data Analysis

Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 28. Qualitative data were analyzed for frequency and percentage. Normality of data was checked using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Intra-group differences were analyzed with the Wilcoxon signed-rank t-test, while inter-group differences were assessed with the Mann Whitney U-test.

3.0 FINDINGS

All the participants who fulfilled the inclusion criteria were selected for the study. Total 40 subjects were selected after meeting the inclusion and exclusion criteria. The participants were divided into 2 groups such as Group A and Group B, each group contained 20 participants respectively. Interestingly, all the subjects were entirely dedicated towards their participants in the study, so there was no drop out case in the presented study. However, the completion of the study demonstrated that total 40 participants and 20 subjects in each group.

After checking the normality of the data via Shapiro-Wilk test, it was found that all variables included in the study do not follow normal distribution. Hence, we cannot apply usual parametric tests i.e., T or Z tests that are used to check the differences between two groups when data follows the normal distribution. In such cases, non-parametric tests are employed to check the differences between the groups. The bar graphs shown below the table show that differences between pre and post values are all negative, hence indicating that the pain has been reduced.

Table 1: Showed the Wilcoxon Signed Rank Test

Variable	Study Group	Sample	Wilcoxon- Signed Rank test		95% Median CI
			Test Statistic	Sig.	
Numeric Pain Rating Scale	PNF	20	-4.134	0.000	(-2.0, -1.5)
	SPENCER METS	20	-4.006	0.000	(-3.0, -2.5)
What is total SPADI Pain Score?	PNF	20	-4.093	0.000	(-2.5, -2.0)
	SPENCER METS	20	-4.042	0.000	(-3.0, -2.5)
What is total SPADI Disability Score?	PNF	20	-4.134	0.000	(-2.5, -2.0)
	SPENCER METS	20	-4.030	0.000	(-3.5, -3.0)
What is total SPADI Score?	PNF	20	-3.999	0.000	(-3.0, -2.5)
	SPENCER METS	20	-3.994	0.000	(-3.0, -2.5)

The Mann Whitney test was applied to check the differences between the two treatments as both groups have different patients here and hence are independent from each other. In such cases, independent t test is applied when data follows normal distribution. Mann Whitney test comes in handy if data is not normally distributed. Contrary, the mean ranks in post data are significantly different in two study groups. Spencer Mets treatment group has lower mean ranks in all scales as compared to PNF study group. It indicated that Spencer Mets had been more effective in reducing the pain of the patients as compared to PNF treatment.

Table 2: Showed the Mann Whitney Test

Variable	Pre/Post	Sample	Mann Whitney Test			
			Test Statistic	Sig.	Z Score	Asymptotic Sig.
	Pre	40	210	0.799	0.411	0.681
Numeric Pain Rating Scale	Post	40	122	0.035	-2.565	0.010
What is total SPADI Pain Score?	Pre	40	184.5	0.678	-0.499	0.618
	Post	40	130	0.060	-2.617	0.009
What is total SPADI Disability Score?	Pre	40	184.5	0.678	-0.553	0.580
	Post	40	70	0.000	-4.064	0.000
What is total SPADI Score?	Pre	40	168	0.398	-1.025	0.305
	Post	40	120	0.030	-2.726	0.006

This indicated that patients in both study groups were experiencing alike level of pain before receiving the treatments. The mean ranks in post data are significantly different in two study groups. Spencer mean Mets treatment group has lower mean ranks in total SPADI pain as compared to PNF study group. It indicates that Spencer Mets has been more effective in reducing the pain of the patients as compared to PNF treatment.

Discussion

The findings of this study align with previous research that has explored conservative treatments for adhesive capsulitis. The substantial reduction in pain intensity observed in both the PNF Stretch and Spencer MET groups is consistent with prior studies that have demonstrated the effectiveness of manual therapy and stretching techniques in alleviating pain for patients with frozen shoulder (13). Pain reduction is a crucial aspect of adhesive capsulitis management, as it significantly impacts the quality of life for affected individuals. Improving functional ability is another essential component of adhesive capsulitis treatment. Patients often face limitations in their daily activities due to the restricted range of motion in the affected shoulder.

In this study, both treatment groups exhibited significant improvements in functional ability, as

evidenced by the reductions in SPADI scores. This finding underscores the importance of incorporating functional rehabilitation into the treatment of adhesive capsulitis, a point supported by previous research (14). Early interventions that focus on exercises and manual techniques can play a pivotal role in enhancing functionality for patients with frozen shoulder. An intriguing aspect of this study is the direct comparison between PNF Stretch and Spencer MET. A single centered experimental study design was conducted by Ravichandran & Balamurugan in 2015 at Chennai, India. It showed that proprioceptive neuromuscular facilitation technique was effective in

relieving pain, restoring ROM, and restoring function among subjects with adhesive capsulitis (15). However, this study showed the effectiveness of proprioceptive neuromuscular facilitation(PNF) stretch on decreasing pain in patients with adhesive capsulitis. Another study designed by H.Mehta an orthopaedic surgeon in 2013, concluded that PNF stretching appears to be more effective in improving glenohumeral joint mobility and reducing impairment in patients with ACAs compare to self-stretching. This study supports that proprioceptive neuromuscular facilitation(PNF) stretch is effective in reducing pain and impairment in patients with adhesive capsulitis. While both techniques proved effective, Spencer MET demonstrated superior outcomes in terms of pain reduction and functional improvement. This finding adds to the evolving body of literature suggesting that METs may hold promise as an advanced treatment modality for adhesive capsulitis. However, it is noteworthy that there is a paucity of existing research directly comparing these two techniques in the context of frozen shoulder, making this study a valuable contribution.

Limitations

There were some limitations in the study regarding a specific age group 30-60 years, and the stages of adhesive capsulitis that must be 2nd and 3rd stage of frozen shoulder. In addition, time was also limited in this study about 4 weeks, if this study will be conducted for a long time like 6-8 weeks' results would be more accurate and effective. The limitations faced also include the characteristics of methodology that influenced and impacted the interpretations and analysis of the study, the paramount acknowledgement that could be done in this study the discontinuous data that revealed during the analysis and interpretation. The discontinuous data that was deviated from the normal, which became clear after checking the normality of the data by applying the Shapiro Wilk and Kolmogorov-Smirnov tests gave us the limitation regarding the study and this step of limitation should be consider the best recommendation for the future study.

4.0 CONCLUSION AND RECOMMENDATIONS

Conclusion

The result of the research has concluded after the completion of study. Spencer mean Mets treatment group has lower mean ranks in total SPADI pain as compared to PNF study group. It indicates that Spencer Mets has been more effective in reducing the pain of the patients as compared to PNF treatment.

Recommendations

Based on the outcomes of this study, several recommendations can be made for clinical practice and further research:

Incorporate Spencer MET into Clinical Practice: Healthcare professionals involved in the treatment of patients with adhesive capsulitis should consider the incorporation of Spencer MET as a viable option for pain management. The superior pain reduction observed in this study suggests

that this technique may yield favorable results in real-world clinical settings.

Comprehensive Assessment: When evaluating and treating patients with adhesive capsulitis, a comprehensive assessment should be conducted to determine the most suitable manual therapy technique. Factors such as the patient's individual characteristics, preferences, and specific clinical presentation should be considered in the decision-making process.

Future Research: While this study offers valuable insights, further research is warranted to explore the long-term effects and potential differences in functional outcomes between Spencer MET and PNF treatment. Comparative studies with larger sample sizes and extended follow-up periods can provide a more comprehensive understanding of the benefits of these techniques.

Patient-Centered Care: Healthcare providers should engage in patient-centered care, involving patients in the decision-making process regarding their treatment approach. This collaborative approach can lead to improved patient satisfaction and outcomes.

Multidisciplinary Approach: Considering the multifaceted nature of adhesive capsulitis, a multidisciplinary approach involving physical therapists, orthopedic surgeons, and pain management specialists may be beneficial. Such collaboration can address the diverse needs of patients and enhance their overall well-being.

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